I. C. 6962 October 1937

DEPARTMENT OF THE INTERIOR

UNITED STATES BUREAU OF MINES
JOHN W. FINCH, DIRECTOR

INFORMATION CIRCULAR

MINING AND GRINDING METHODS AND COSTS AT THE MALVERN CLAY CO. MINE, MALVERN, OHIO

BY

E. J. LINTNER

AFTER THIS REPORT HAS SERVED YOUR PURPOSE AND IF YOU HAVE NO FURTHER NEED FOR IT, PLEASE RETURN IT TO THE BUREAU OF MINES, USING THE OFFICIAL MAILING LABEL ON THE INSIDE OF THE BACK COVER.

Generated on 2024-09-18 03:10 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

I.C. 6962
October 1937

INFORMATION CIRCULAR

DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

MINING AND GRINDING METHODS AND COSTS AT THE MALVERN CLAY MINE, MALVERN, OHIO[1]

By E. J. Lintner[2]

INTRODUCTION

This paper is one of a series being prepared by the United States Bureau of Mines describing clay mining, crushing, and grinding methods and costs at various operations throughout the United States. These papers are designed to disseminate technical information regarding methods used. The cost tabulations represent local operating expenditures only and not total production costs. It is recognized that in many instances publication of total production costs may cause embarrassment to the individual operator as well as to the industry as a whole. On the other hand, operating costs are essential to a technical discussion and study of the methods employed. The attention of the reader is called specifically to this differentiation in order that no misunderstanding of the scope of the cost tabulations shall ensue.

The following report deals with the methods employed by the Malvern Clay Co., Malvern, Carroll County, Ohio.

The author wishes to acknowledge the assistance of the following persons: H. C. Ross, vice-president and general manager, and H. C. Downer, secretary and treasurer.

BRIEF HISTORY AND EARLY DEVELOPMENT OF DISTRICT

The ceramic industry in Carroll County had its beginning in the summer of 1886, when John Kratz conducted a search for fireclay in the vicinity of Malvern, Brown Township. He discovered clay of excellent quality on the farm of Col. David Roach, adjoining the village of Malvern. In the fall of this same year, Ross Rue, of Alliance, Ohio, became associated with Kratz, and they organized a company known as Kratz & Rue. A plant was erected during the winter of 1886-87 to manufacture paving brick. This is said to have been the first plant in Ohio to manufacture paving brick from fireclay[3].

1/ The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6962."

2/ Associate mining engineer, U. S. Bureau of Mines, Washington, D. C.

3/ Ries, Heinrich, and Leighton, Henry, History of the Clay; Working Industry in the United States: John Wiley & Sons, New York, p. 172, 1909.

Generated on 2024-09-18 03:10 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Several other companies were organized soon thereafter, all in the valley of Sandy Creek[4]. The valley became known as the Sandy Valley district of Carroll and Stark Counties.

The Malvern Clay Co. was organized in 1911 by H. C. Downer and I. H. and H. C. Ross. The company was incorporated on October 26, 1911, under the laws of West Virginia. A site in the well-known Sandy Valley district of Carroll County was chosen and on April 16, 1912, construction of the plant buildings was begun. A slope was driven into the hillside piercing the Middle Kittanning beds of coal and clay. Machinery was installed in the plant to manufacture fireproofing products, and the first were produced on October 12, 1912. The plant was destroyed by fire on July 1, 1919, but it was rebuilt immediately and placed in operation on September 9, 1919. New machinery installed shortly after more than doubled the original capacity of the plant[5]. Improvements and additions have been made since that have enabled this plant to become one of the largest in Ohio manufacturing fireproofing materials.

The plant is situated about 1 mile east of Malvern. It is served by both the Wheeling and Lake Erie RR. and the Pennsylvania RR. Improved highways also permit rapid trucking service to all points. Figure 1 shows the Sandy Valley district of Carroll and adjoining counties.

GEOLOGY

The clay mined in the Sandy Valley district is known as the Middle Kittanning. This is a member of the Allegheny formation of the Pennsylvanian system.

The Allegheny is the great clay-bearing formation of Ohio, and its thickness ranges from 175 to 250 feet, averaging 200 feet. All of the more important clay beds are found in this formation. These beds, in ascending order, are the Winters, Clarion, Lower Kittanning, Oak Hill, Middle Kittanning, Lower Freeport, Boliver, and Upper Freeport[6]. The Lower Kittanning is the most important member of this group, while the Middle Kittanning is given third place in order of importance in the scale of Ohio clays[7].

4/ Eckley, H. J., and Perry, W. T., History of Carroll and Harrison Counties, Ohio: Lewis Publishing Co., Chicago and New York, 1921, p. 174.
5/ Eckley, H. J., and Perry, W. T., History of Carroll and Harrison Counties, Ohio: Lewis Publishing Co., Chicago and New York, 1921, p. 176.
6/ Stout, Wilbur, Stull, R. T., McCaughey, Wm. J., and Demorest, D. J., Coal Formation Clays of Ohio: Geol. Survey Ohio, 4th ser., Bull. 26, 1923, p. 243.
7/ See footnote 6, p. 396.

Generated on 2024-09-18 03:13 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

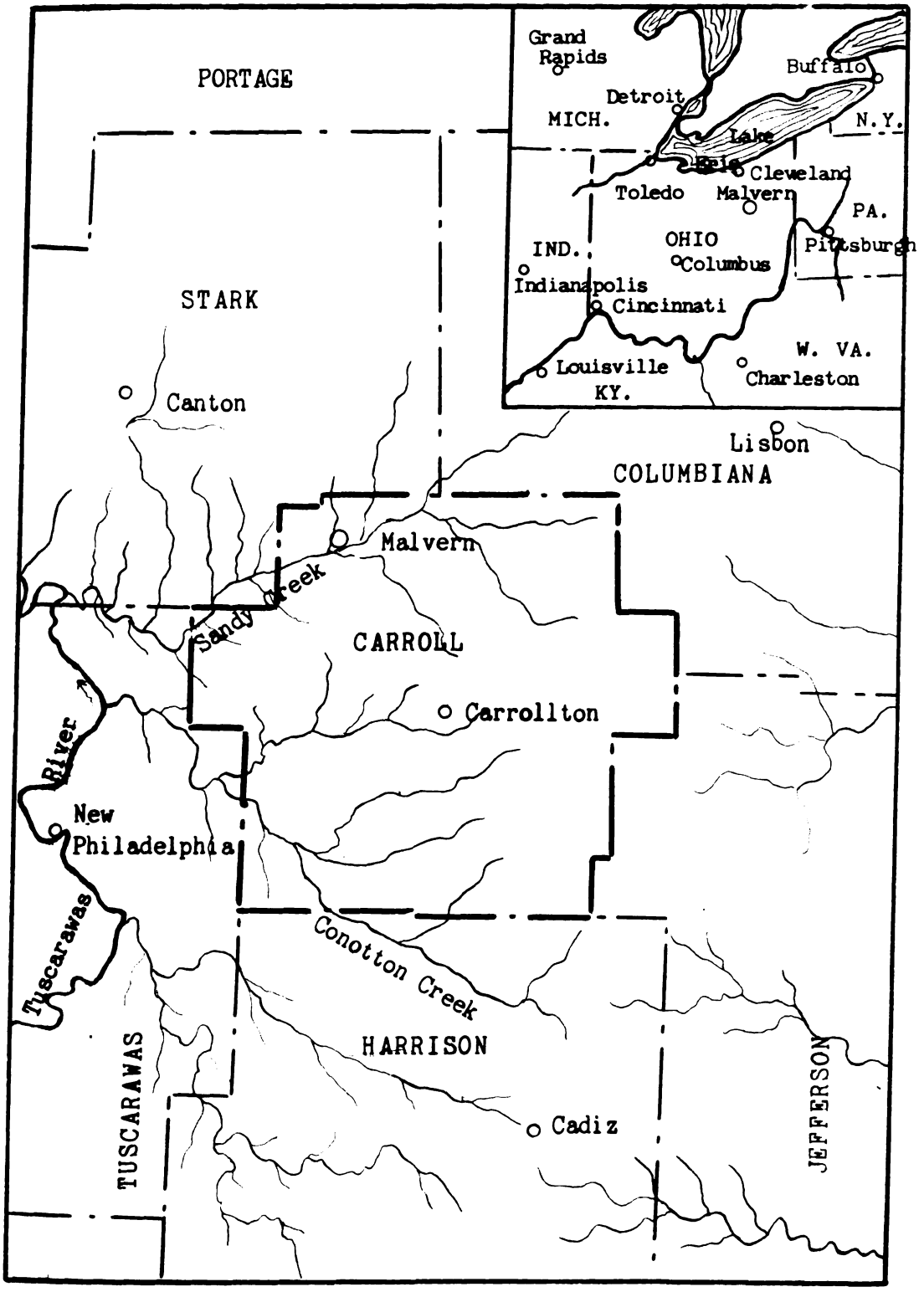


Figure 1.– Sandy Valley district of Carroll and adjoining counties, Ohio.

Generated on 2024-09-18 03:15 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

A general section of the clay-bearing rocks of the Allegheny formation of Ohio is as follows:8/

Member	General description	Thickness Feet	Thickness Inches
Upper Freeport No. 7	Coal, when present, usually thick.	3	0
	Clay rather persistent.	4	0
	Shale.	3	0
Upper Freeport	Limestone locally present.	2	0
Bolivar	Coal, thin, generally wanting.	0	3
	Clay, locally flinty, often thick.	5	0
	Shale and sandstone.	33	0
Lower Freeport No. 6a	Coal, thin and unsteady.	1	0
	Clay, siliceous, often wanting.	2	6
Lower Freeport	Limestone locally present.	1	0
	Shale and sandstone.	40	0
Middle Kittanning, No. 6	Coal, steady but variable thickness.	3	6
	Clay, widely distributed, locally of value.	5	0
	Shale and sandstone.	15	0
Oak Hill	Clay, well developed in parts of field.	4	0
	Shale.	3	0
Hamden	Limestone, unsteady.	1	0
	Shale, fossiliferous.	3	0
Lower Kittanning No. 5	Coal, fairly steady.	2	4
	Clay, widely distributed, excellent quality.	8	0
	Shale and sandstone.	13	8
Vanport	Limestone, unsteady.	6	0
	Shale and shaly limestone.	4	0
Clarion No. 4a	Coal, locally important.	4	0
	Clay, in places of value.	4	0
	Shale and limestone.	10	0
Winters	Coal, local.	3	0
	Clay, generally wanting.	4	0
	Shale and sandstone.	23	0
Putnan Hill	Limestone, steady in central part of field.	4	0
Brookville No. 4	Coal, steady, often thin.	2	0

The Middle Kittanning member is a persistent one, extending northeast across the eastern end of the State of Ohio. This member is composed of a bed of coal underlain by a bed of fire clay. The thickness of these two

8/ Stout, Wilbur, Stull, R. T., McCaughey, Wm. J., and Demorest, D. J., Coal Formation Clays of Ohio: Geol. Survey Ohio, 4th ser., Bull. 26, 1923, p. 243.

Generated on 2024-09-18 03:10 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

beds varies throughout the State, that of the clay from 1 to 10 feet, averaging 5 feet, while the thickness of the coal ranges from 3 to 5 feet, averaging 3 feet 6 inches. In the Sandy Valley district the clay averages 7 feet 3 inches in thickness, while that of the coal is 3 feet. In the mine of the Malvern Clay Co. these two beds average 9 feet 6 inches, and 3 feet 8 inches, respectively.

The clay bed, throughout its horizon across the State, ranges from clay of good quality to shale. The Sandy Valley district comprises the most important section of the entire field, the clay being of excellent quality and above average thickness.

The topography of the county is accentuated by erosion. Hills rise approximately 200 feet above the floor of the valley throughout the district. The county is drained by Sandy Creek, which in turn empties into the Tuscaramas River.

PHYSICAL CHARACTERISTICS OF THE DEPOSIT

The clay in the mine of the Malvern Clay Co. is composed of three separate beds. The top bed directly beneath the coal is light gray and averages 5 feet in thickness. The second or middle bed is dark gray and ranges from 8 inches to 4 feet in thickness; in some places it closely resembles flint clay in appearance, while in other places it assumes the physical characteristics of shale. The bottom bed is dark gray and 3 to 6 feet thick. The three beds of clay are mined together. The resultant product is a plastic clay that is coarse and gritty, possessing a low bonding power and weathering rapidly upon exposure to the elements.

The Middle Kittanning coal is the most important bed in Ohio. It is mined in virtually every county through which it extends. This bed consists of three benches of variable thickness separated by layers of shale or clay, whose thickness also varies from place to place[9]. The bed at Malvern averages 3 feet 8 inches in thickness. The contacts between the three benches are hardly discernible, due to the thinness of the shale or clay parting. The coal is of excellent quality, having little sulphur and a low ash content. It is mined either before or after the clay has been recovered and is used in firing the kilns.

METHODS OF PROSPECTING AND EXPLORATION

The management did not deem it advisable to do any prospect drilling. It assumed clay beds were present on its property as it lay between the lands of other operating companies. Their assumption proved correct, as the Middle Kittanning member was readily located and was found to be of unusual thickness.

9/ Bownocker, J. A., and Dean, Ethel S., Analysis of the Coals of Ohio: Geol. Survey Ohio, 4th ser., Bull. 34, 1929, p. 71.

Generated on 2024-09-18 03:15 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Later, a hole was drilled for water, and it disclosed the following structure:

	Feet	Inches
Blue shale	29	0
Lower Kittanning No. 5:		
Coal	1	10
Clay	11	0
Brown shale	3	0
Blue shale	12	0
Sandstone	10	6

This hole was drilled beside the boiler room on filled ground. The absence of the Middle Kittanning member, which should lie directly above the first blue shale, is undoubtedly due to the erosive action of Sandy Creek. The structure disclosed by the drill hole, however, corresponds closely to the general geological section of the Allegheny formation.

METHODS OF SAMPLING AND ESTIMATION OF TONNAGES

The Middle Kittanning clay bed is so uniform that it is unnecessary to sample and analyze it continually to maintain a quality product. A chemical analysis of the clay is as follows:

Silica (SiO_2)	51.50
Alumina (Al_2O_3)	26.45
Iron oxide (Fe_2O_3)	5.86
Titanium oxide (TiO_2)	1.00
Calcium oxide (CaO)	1.00
Magnesium oxide (MgO)	.83
Alkali oxides	2.33
Sulphuric anhydride	.20
Loss on ignition	10.40

A typical analysis of the Middle Kittanning or No. 6 coal from the Sandy Valley district is as follows[10]:

Proximate Analysis

	As received	Moisture-free
Moisture	6.66	0.00
Volatile matter	36.24	38.82
Fixed carbon	48.88	52.37
Ash	8.22	8.81

10/ Bowmocker, J. A., and Dean, Ethel S., Analysis of the Coals of Ohio: Geol. Survey Ohio, 4th ser., Bull. 34, 1929, p. 80.

Generated on 2024-09-18 03:08 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Ultimate Analysis

	As received	Moisture-free
Carbon	68.94	73.86
Hydrogen	5.37	4.96
Oxygen	13.61	8.24
Nitrogen	1.20	1.28
Sulphur	2.66	2.85
Ash	8.22	8.81

CHOICE OF MINING METHOD

The Middle Kittanning member in the Sandy Valley district is found above the water level in the surrounding hills. It lies in a horizontal position suitable for a room-and-pillar system of mining. Clay at such a shallow depth usually is reached through a slope driven downward into the clay bed, and this is connected to a tipple leading to the crusher building.

MINING METHODS

Mining

The slope entering the mine of the Malvern Clay Co. is 6°, or approximately 10 percent downgrade. It is 125 feet in length from the entrance to the foot and measures 6 feet wide by 6 feet high inside the timber. Three-piece timber sets made of 8- by 8-inch square-cut oak are placed on 4-foot centers and lagged with 2- by 8-inch oak along the entire length. Figure 2 illustrates the method of timbering.

The single-entry system of mining is employed. Rooms, entries, and crosscuts are driven 12 feet in width. Rooms are placed on 80-foot centers, forming pillars 68 feet wide. Crosscuts are placed on centers varying from 50 to 125 feet. (Fig. 3.)

The Middle Kittanning No. 6 bed of coal is mined along with the clay by two different methods. In the first method, two miners working alone are employed in one section of the mine to recover the coal. They remove the coal from the top of the clay bed, advancing the coal face to a point about 14 feet ahead of the clay face. Coal mining is discontinued at this point and all loose coal is removed from the top of the clay bed. The clay drillers now move in and drill the clay. A drill round will advance the clay face from 8 to 9 feet. This leaves a small bench of solid clay, upon which the coal miner can resume his work after the broken clay has been removed. Figures 4, A, and 4, B, show, respectively, the rounds of holes employed for mining the coal and clay separately.

In the second method of coal recovery, the coal face is drilled along with the clay face. This work is performed by a two-man drill-crew using a mounted electric rotary drill. The method of placing the holes in both

Generated on 2024-09-18 03:09 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-18 03:08 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

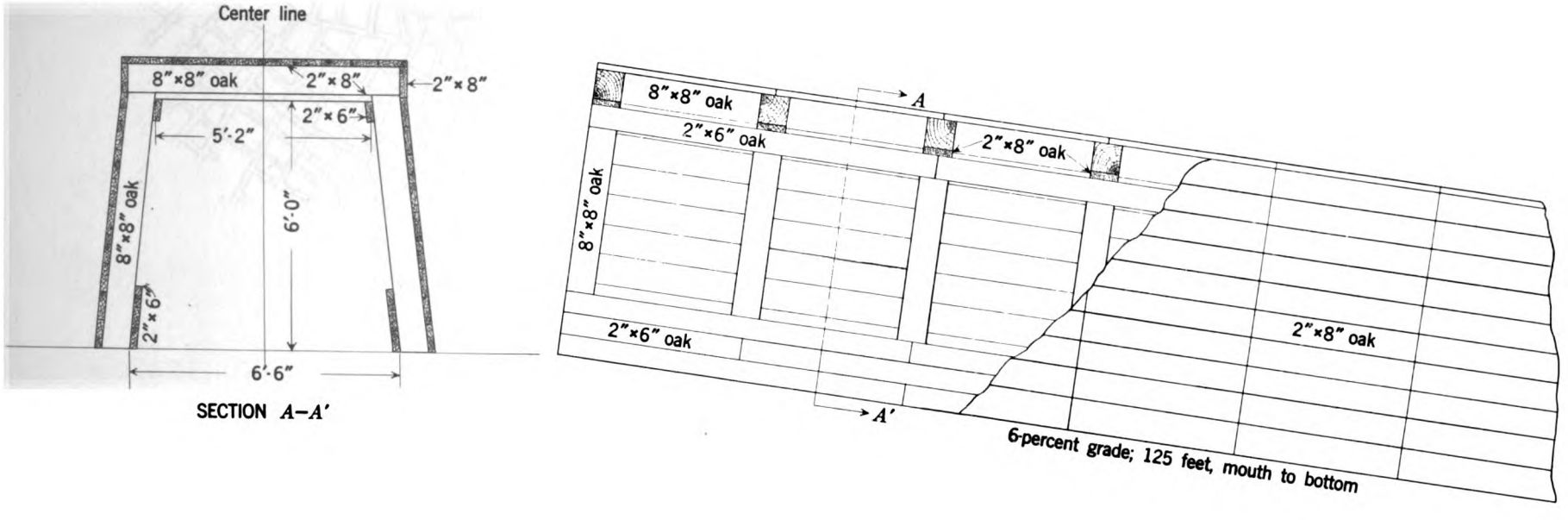


Figure 2.—Slope timbering.

Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-18 03:12 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

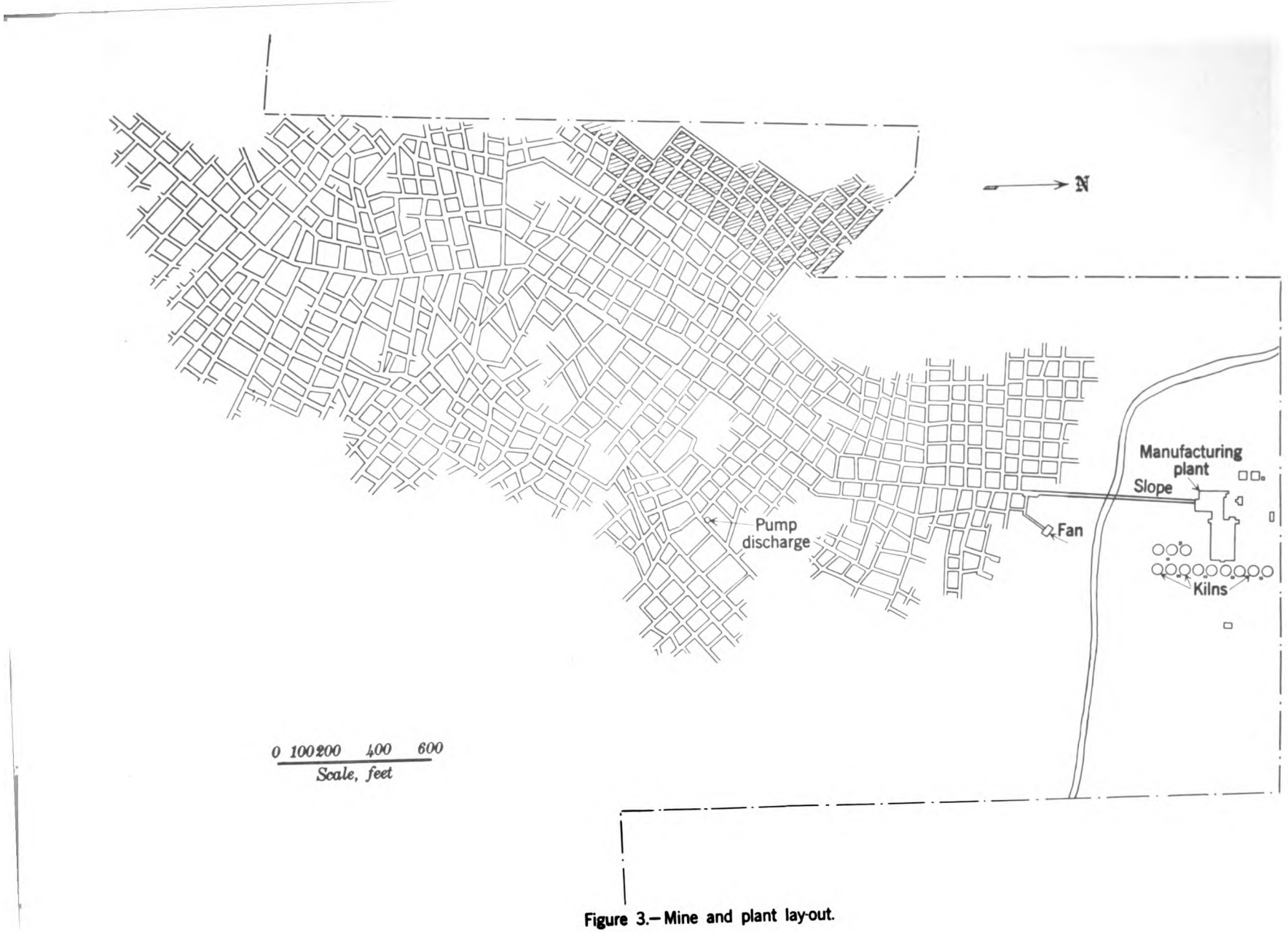


Figure 3.—Mine and plant lay-out.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-18 03:10 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

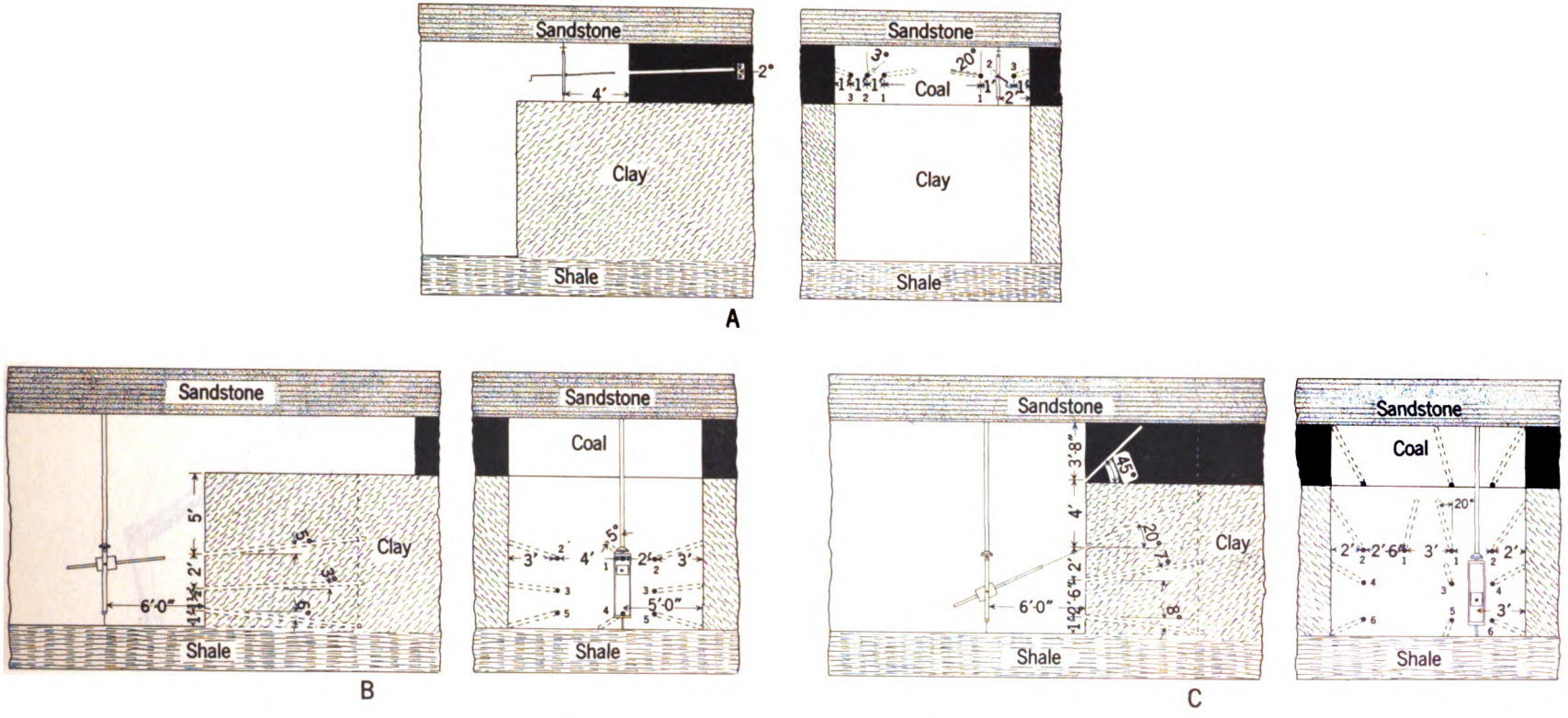


Figure 4.—A, Drill round in coal; B, drill round in clay; C, drill round in coal and clay.

Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-18 03:13 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

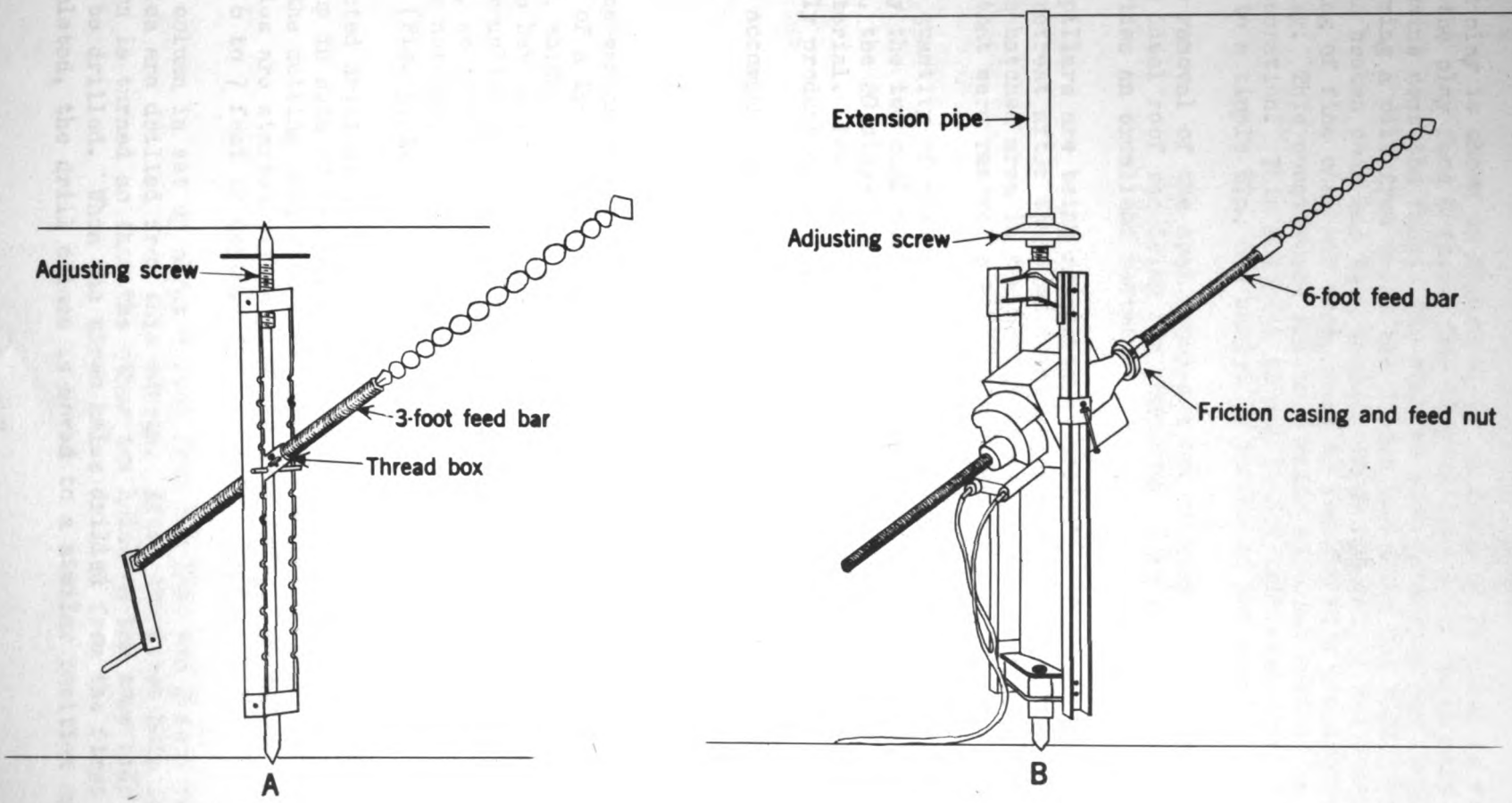


Figure 5.—A, Hand auger; B, electric rotary drill.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

coal and clay is shown in Figure 4, C. A round of 10 holes is fired, advancing the clay face 8 feet. The clay is loaded out until only a small pile remains near the face. The coal is shot down upon the loose clay, thus forming a pile from which the loader can dress the high coal face. After the broken coal has been loaded, about one car of waste material, consisting of fine coal and clay, must be removed from the surface of the loose clay. This constitutes the only waste material handled in the entire mining operation. This material is all loaded into mine cars, transported outside to a tipple bin, and hauled by trucks to the dump.

The removal of the coal exposes a bed of hard, firm sandstone that forms an ideal roof requiring few supports. Hard shale beneath the clay bed provides an excellent bottom.

No pillars are being recovered at present. It is planned to do this work in retreat after the mine workings have reached the property limits. The cross-hatched area in the northwest corner of the mine (fig. 3) denotes pillars that were removed several years ago.

The quantity of coal mined averages 64 tons daily, 20 tons being loaded by the two coal miners and the balance by the clay miners. In addition, the 20 clay loaders will produce 350 tons of clay and 12 tons of waste material. The total number of men employed underground to maintain this daily production is 35.

The accompanying map (fig. 3) shows the mine workings and the plant lay-out.

Drilling Coal

A one-man hand-auger drill is used in mining the coal. The machine consists of a 1¼-inch-diameter feed bar 36 inches long, having 6 threads per inch, which is rotated by a removable handle, 12 inches long, on the end. The bar is fed through a bronze thread box fitted with lugs that permits mounting on a short double or split steel column. The thread box is split, so that the feed bar can be set into place easily. The drill column is notched, thus permitting a quick adjustment of the drill to any height. (Fig. 5, A.)

Twisted drill steel 2 inches in diameter, having 5½ turns per foot, is made up in sets of 2-, 4-, 6-, and 8-foot lengths. A fishtail bit is used on the cutting end, with a ¾-inch-square tapered shank on the other end. Holes are started with a pick and then drilled 2½ inches in diameter and from 6 to 7 feet in depth.

The column is set up about 4 feet from the face and 2 feet from the rib, and 3 holes are drilled from this set-up. After the first hole is drilled, the column is turned so that the other two holes on the same side of the room can be drilled. When the three holes drilled from the first set-up have been completed, the drill column is moved to a similar position on the

Generated on 2024-09-18 03:12 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

opposite side of the room. A single row of six holes is drilled in the face. They are collared in the center of the face vertically and are inclined at an angle of 2° above the horizontal. The rib holes are collared 12 inches from the rib and end in the rib itself. The second hole is collared 12 inches from the rib hole, and pointed 3° towards the center of the face. The center or cut holes are collared 6 feet apart and 12 inches from the second holes and are pointed 12° towards the center of the face. Figure 4, A, illustrates the position of the drill and the direction of the holes.

The miner can easily drill at a rate of 12 inches per minute in clean coal. However, his drilling speed is cut to 8 inches when pyrite is encountered.

The entire six holes are not necessarily drilled at one time. The center-cut holes are always drilled and fired first. The miner then starts loading the loose coal and drills the remaining holes while waiting for empty cars. Either pair of end holes is fired next. The miner working in this manner always has a quantity of broken coal to load as well as a place in which to drill. These men drill one to three holes and load an average of 10 tons of coal daily.

Two men are employed continually in mining coal, their remuneration being on a tonnage basis. They are required to furnish their own drills, tools, and explosives.

Drilling Clay

Electric rotary drills operated by two men are used to drill the clay. These machines are equipped with a 1½-inch-diameter solid feed bar 6 feet long and having six threads per inch. This bar passes through a hollow armature shaft and rotates at 106 r.p.m. A feed nut contained in a friction casing is attached to the forward end of the drill-machine housing. The forward movement of the feed bar is controlled by varying the friction of the feed-nut casing by means of a thumbscrew. Little adjusting is necessary in soft material. However, when hard material is encountered, the releasing of the friction nut instantly stops the forward movement of the feed bar but does not stop its rotation. This feed-pressure device permits drilling hard material that could not be drilled by a positive feed bar. The drill machine is powered by a 3-horsepower, 250-volt, series-wound motor. Figure 5, B, is a sketch of this drill.

Two-inch-diameter twisted drill steel having 5½ turns per foot is used. This is made up in sets of 2-, 4-, 6-, and 8-foot lengths, with a 3-inch fishtail bit on the cutting end and a ¾-inch-square tapered shank on the other end. Two 1½-inch-diameter extension bars, 18 and 30 inches long, are used to give additional length to the feed bar.

Generated on 2024-09-18 03:09 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

The drill is mounted in a saddle placed on a double column so that it can be adjusted to any height. The column itself is only 4 feet high. Extension pipes 2½ inches in diameter and 5, 6, and 8 feet in length are placed over an adjusting screw on the column to obtain the proper height desired.

A flexible, duplex, rubber-insulated cable, 125 feet in length, wound on a reel 10 inches in diameter by 18 inches in length, carries the direct current from the end of the permanent wiring to the working face. A short length of similar cable furnishes the connection between reel and drill.

The drill outfit is moved from place to place on a small, light, double-deck flatcar 5 feet long by 29 inches wide. The lower deck carries the extension pipes and the 6- and 8-foot lengths of drill steel. The remaining equipment is carried on the top deck. The cable reel is mounted 8 inches above the top deck at the rear end of the car.

A typical drilling cycle in a working place where both clay and coal are drilled is as follows: The column, with the drill attached, is set at a point 6 feet behind the face and 3 feet from the right-hand rib. An extension pipe of the proper length is placed over the adjusting screw and the column securely fastened in position.

Six holes in three rows of two each are drilled in the clay face and two holes in the coal bed above. The three rib holes are collared 2 feet from the rib and end in the rib itself. The center line of three holes is pointed 20° toward the center of the face. The two top holes are collared 4 feet below the coal, are inclined 20° above the horizontal, and end about 12 inches below the coal. The two middle holes are collared 2 feet above the top row and are inclined 7° above the horizontal. The two bottom holes are collared 2½ feet below the middle row, or 1 foot above the floor. These holes are inclined 8° below horizontal and end in the floor.

The holes drilled into the coal bed are collared at the bottom edge of the coal face and end a few inches below the roof line. These holes are placed in line and direction over the holes in the clay face below, but their inclination is 45° above the horizontal while their depth is only 5 feet. After completion of these 8 holes the column is moved into position 6 feet behind the face and 3 feet from the left-hand rib. From this position, three rib holes and one top-center hole are drilled in the clay, while one rib hole is placed in the coal bed. The four rib holes are placed similarly to those on the opposite rib. The one center-cut hole placed in the top row is collared 4 feet below the coal and 2½ feet from the top rib hole. This hole is drilled at an angle of 20° toward the center of the face and is inclined 20° above the horizontal to cut off the top center hole from the opposite side.

The top row of four holes in the clay is drilled to a depth of 9 feet, the remaining clay holes to a depth of 7 feet. Figure 4, C, shows this drill round in detail.

Generated on 2024-09-18 03:14 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

The speed of drilling varies with the bed of clay. The drilling rate in the bottom bed is 16 inches per minute, while in the middle and top beds it will average 18 inches per minute. The faster rate of drilling will require approximately 0.023 kw.-hr. of electric energy per foot of hole drilled. The drilling rate in the coal is 29 inches per minute, requiring an electrical demand of 0.030 kw.-hr. per foot.

In a working day of 8 hours, two men on each machine will drill 30 holes. These men, in addition to the drilling, also load and shoot each face.

The round of 10 clay holes advances the face about 7 feet, thus exposing the bed of coal overhead. The three coal holes are fired later, bringing the coal down even with the clay face.

In drilling the clay in those rooms where the coal has already been recovered, the machine is set up 5 feet from the rib and 6 feet behind the face. The top row of three holes is collared 5 feet below the top of the clay bed. The holes are inclined 5° above the horizontal and drilled 10 feet deep. The middle row of two holes is collared 2 feet below the top row. The holes are inclined 3° above the horizontal and drilled to a depth of 8 feet. The bottom row of three holes is collared 1 foot above the floor level. These holes are inclined 6° below the horizontal and drilled 8 feet deep. The three rib holes are collared 3 feet from the rib and end in the rib. The center line of two holes is collared 2 feet from the rib holes and they are pointed at an angle of 5° towards the center of the new face. Figure 3,c, illustrates the method of placing these holes.

Blasting Coal

FFF black powder is used in blasting the coal. This is made into cartridges 2 inches in diameter by 4 inches in length and is fired with fuse. Tamping shells, 2 by 14 inches, are rolled from newspaper and filled at the face with coal cuttings. Twenty pounds of powder are used in firing the six holes, approximately 2 1/3 pounds per hole; this will break 25 tons of coal, at the rate of 1¼ tons of coal per pound of powder and 0.57 ton per foot of hole drilled.

Three coal holes drilled in those rooms where the clay is recovered first are each loaded with two sticks of 40-percent nitroglycerin dynamite, size 1¼ by 8 inches. The total charge of 3 pounds of explosive will break 22 tons of coal, roughly 7 1/3 tons per pound. A V-shaped slide is used in loading these holes, due to their height above the floor level. This slide is made with two pieces of ¾- by 2-inch lumber 7 feet long. One man places the end of the slide to the collar of the hole, inclining it at the same angle as the hole itself. He then places the two sticks of dynamite on the slide and the second man pushes them into place with his tamping bar. Stemming is added in a similar manner.

Generated on 2024-09-18 03:08 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Blasting Clay

The clay is blasted with 40-percent nitroglycerin dynamite, using No. 6 detonators and triple-taped safety fuse in 7-foot lengths. The fuse is laced through the stick of dynamite and the cap is inserted in the middle of the stick.

In rooms where the clay is shot from beneath the coal, the holes are loaded as follows: Ten sticks of dynamite are first slit and then firmly tamped into the four top holes. The middle row of holes contains 15 sticks each, while 12 sticks are placed in each of the three bottom holes. The stick containing the blasting cap is usually placed third from the last. Stemming cartridges, 2 by 14 inches, rolled from newspaper and filled with clay cuttings, are added to the collar of the hole. The fuses protruding from the various holes are now trimmed to their proper length to cause the holes to fire in the order shown in figure 3, C, the order of firing being denoted by the number beside each hole.

Approximately 50 pounds of dynamite are placed in each round of 10 holes. This charge will break 110 tons of clay, or at the rate of 2.2 tons per pound of explosive and 1.4 tons per foot of hole drilled.

An equal amount of dynamite is placed in the round of holes drilled in the clay bed where the overlying coal has already been recovered. These holes, being slightly deeper and having two free faces, will break 145 tons of clay. This is the equivalent of 2.9 tons per pound of dynamite or 1.9 tons per foot of hole drilled.

The tamping bar is made of 1-inch-diameter, galvanized pipe 9 feet in length, having a solid-copper cylinder 2 inches in diameter by 3 inches in length on each end.

All firing is performed at the end of the working shift after the other men have departed from the working places.

Loading

Both coal and clay are loaded by hand. The two coal miners load only the coal they break. Twenty clay loaders are employed in loading both clay and coal in the other working places. These men work alone and average 14 cars or 28 tons of clay per shift of 8 hours. They will average 8 cars each when loading both coal and clay. Waste material loaded will average 1 ton per 55 tons of clay. All loaders provide their own set of tools, such as pick and shovel, and are paid on a tonnage basis.

Transportation

Two trolley locomotives and three storage-battery locomotives are employed. Two 5-ton storage battery locomotives are in daily use, while a third is held in reserve. These locomotives are used to move the cars to

Generated on 2024-09-18 03:09 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

and from the various working places. Each locomotive operates from a separate distribution point inside, where it receives empty cars and where the loads are assembled into trains of 16 cars each, usually 4 cars of coal and 12 cars of clay. The train at this point is coupled to a 7-ton trolley locomotive and started on its way to the slope. Upon reaching a point approximately 800 feet from the slope, the train is pulled onto a side track. The 7-ton locomotive is uncoupled and moves over to the main line alongside. A 5-ton trolley locomotive now moves forward and is coupled to the train. The motorman of the 7-ton locomotive dismounts and cuts the original train into two trains of eight cars each. He then walks forward to a scale, where he weighs each car as the eight-car train is slowly pulled across the platform by the second locomotive. This locomotive then takes the train to the slope, uncouples, and pulls over onto the other track. The motorman connects the hoist cable and the train is pulled to the tipple. After the second train of eight cars has been handled in a similar manner, the 7-ton-locomotive motorman makes up a train of 16 empty cars and returns inside 2,000 feet to the second distributing point.

The three storage-battery locomotives are identical in size and capacity. They are 12 feet long and 4 feet wide and have a 36-inch wheel base. They are powered by a single 40-horsepower, 80-volt, 90-ampere motor that drives each axle through a worm gear. The storage battery itself is made up of 48 cells, each with 27 plates. The original battery remains in the first locomotive purchased in 1929. An extra storage battery is not kept on hand, the third locomotive serving the same purpose.

A charging station large enough to house the five locomotives is beside the main entry at a point 1,500 feet from the slope. The battery locomotives are run into the station at the end of each shift and brought to rest beside their respective charging panel, of which there are two. A single electrical connection is made from the panel to the locomotive, and they are ready for charging. Charging continues until morning. Automatic cut-outs are provided to prevent overcharging. The batteries usually are given an additional heavy charge during the noon lunch hour. The third locomotive is charged while the other two are in use. This locomotive is used occasionally to haul rails, timber, and miscellaneous supplies into various working places during the regular shift hours.

The 7-ton trolley locomotive is powered by two 60-horsepower, 250-volt motors, each driving an axle through a worm gear. The 5-ton trolley locomotive is powered by a single 40-horsepower, 250-volt motor driving the machine through a chain drive to one axle.

The trolley wire used is "0 0" round, suspended 5½ feet above the rail from wood cross arms secured to 3- by 5-inch posts placed every 35 feet. Good bonding of the rails provides a current of 240 volts throughout.

Tracks are 36-inch gage. Thirty-pound rails resting on 3- by 5-inch by 5-foot untreated wood ties placed on 2½-foot centers are used throughout the mine and along the slope. No. 3 frogs are used on both room and siding turnouts. Three men working together as one crew are well able to make all track extensions and repairs.

Generated on 2024-09-18 03:09 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-18 03:15 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

Wheel diameter 16 inches
Wheel face 3 inches
Wheel base 20 inches
Axle diameter 2 inches
Axle length 3 feet 5½ inches

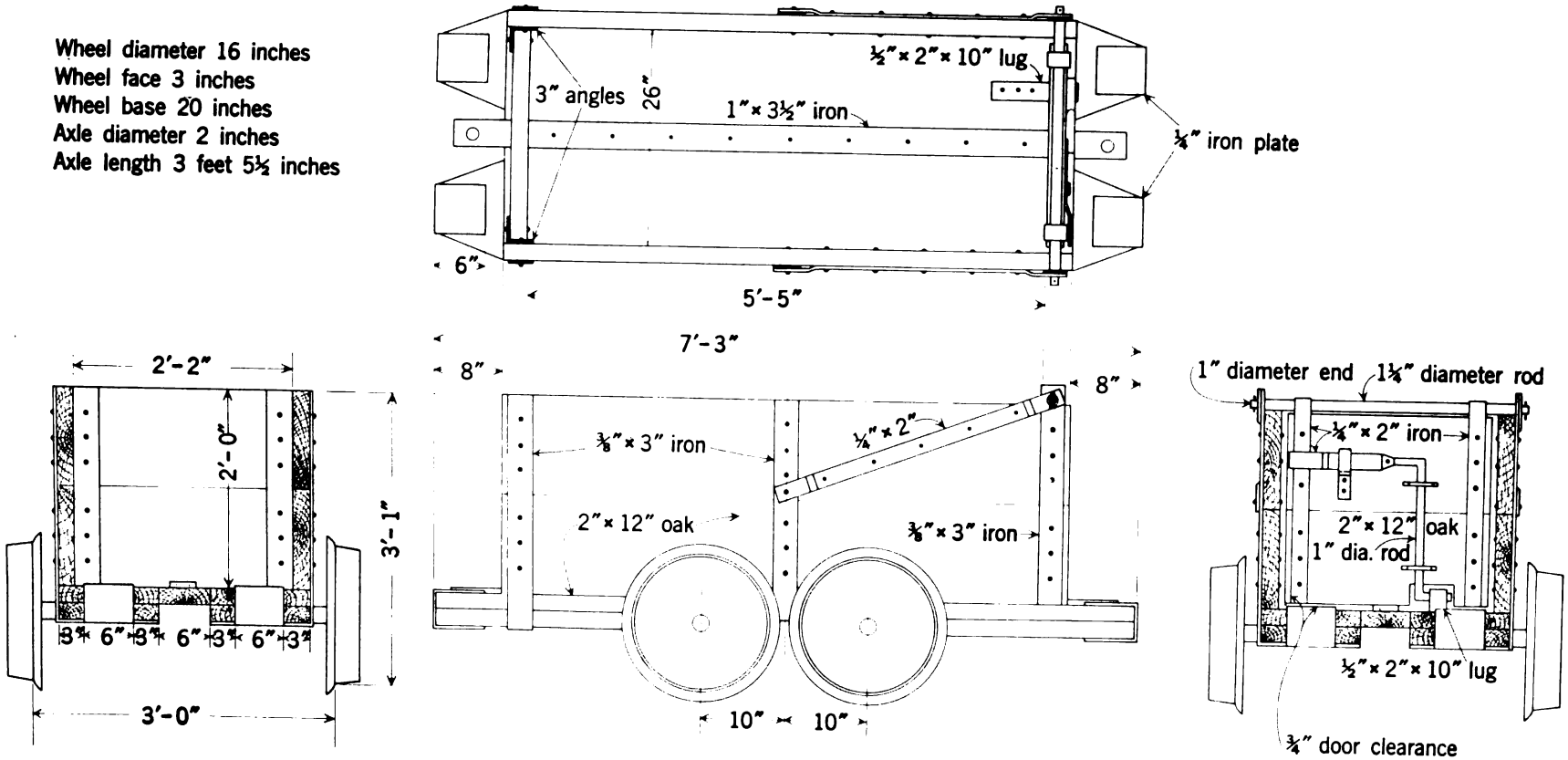


Figure 6.—Mine car.

Original from THE OHIO STATE UNIVERSITY

The mine cars (fig. 6) are of solid wood body construction, made of 2-inch oak, and have 16-inch-diameter wheels set on 20-inch centers. Their capacity is 24 cubic feet; their tare weight is 1 ton. An average net load of 2 tons of clay is carried, while a load of coal will average 1 ton. There are 104 cars in daily use and 16 cars held in reserve and undergoing repairs.

Weighing

The platform scale is placed at a point in the mine 600 feet from the bottom of the slope. It is equipped with a single beam and an 8-foot platform, and its capacity is 5 tons. The cars are weighed while the train slowly passes over the platform. The 20-inch wheel base of the cars permits their remaining upon the 8-foot platform long enough for their weight to be determined.

Timbering

Little timbering is required, due to the excellent sandstone roof. At a few places along the main entry, posts are required where the roof has softened, due to water seepage. A post is required occasionally at a room neck that has been made too wide. The timber used is cut locally and measures 10 inches to 14-inches in diameter on the small end and is 12 to 16 feet in length. A hardwood wedge made of 2- by 10-inch lumber is used to hold the post in position. The life of the timber is 8 to 10 years. The three-man track crew usually performs the little timbering necessary.

Pumping

A limited amount of water is encountered at the working faces, the worked-out area of the mine producing most of the water handled. This water is conducted by ditches and gathering pumps to a large sump in the northeast corner of the mine. Five gathering pumps are in daily use, all identical as to size, capacity, and drive. These pumps are of the single-plunger, self-oiling type, moving at the rate of 50 strokes per minute and having a capacity of 50 g.p.m. each. The cylinder measures 5 by 5 inches and is brass-lined. Each pump is driven through a 4-inch rubber transmission belt on 7-foot centers by a 2½-horsepower, 230-volt, 7.5-ampere motor traveling at a speed of 925 r.p.m. These pumps operate 24 hours daily but not at their maximum capacity. Valves on the various suction lines are adjusted at such a position that each pump handles an amount of water equal to the inflow of the small sumps from which they take their water.

The large sump in the northeast corner of the mine holds 250,000 gallons of water. The sump is nothing more than a low section of the old mine workings extending over a considerable area. A 5-inch, single-stage, centrifugal pump operating against a 90-foot head delivers water to the

Generated on 2024-09-18 03:13 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

surface through a bore-hole nearby. The pump has a bottom suction and discharge and is rated at 600 g.p.m. It is direct-connected to a 25-horsepower, 250-volt, 77-ampere motor traveling at a speed of 1,750 r.p.m.

This pump operates approximately 7 hours daily throughout the year. It is placed in operation by a mechanic at the end of the working shift, 3:30 p.m., and operates until the sump has been emptied. At the moment the pump starts taking air, an automatic switch cuts off the current. At the present rate of clay production, approximately 830 gallons of water are handled for each ton of clay mined.

Ventilation

An 8-foot-diameter fan provides the necessary ventilation. Eight blades, 18 by 34 inches, are placed on a double spider and turn at a speed of 120 r.p.m. The fan exhausts the air from the mine at the rate of 21,000 cubic feet per minute, the main slope serving as the intake. The fan is driven through a 3- by 40-inch flat chain by a 10-horsepower, 250-volt, 27.3-ampere motor traveling at a speed of 850 r.p.m.

The fan is 200 feet east of the slope and is housed in a substantial brick building measuring 8 feet by 12 feet in plan. A horizontal airway 6 feet wide, 8 feet high, and 40 feet long leads from the mine workings to the fan. The airway is lined with 12-inch hollow tile and is arched at the top. This opening also serves as an escapeway.

Brattices are made of 12- by 12- by 12-inch hollow tile. Proper control of the air current provides excellent ventilation throughout the mine.

Hoisting

A single, cone-friction-drum, electric, geared hoist is used to pull a trip of eight cars from the slope bottom. The drum is 18 inches in diameter, and 18 inches long, and turns at a speed of 60 r.p.m. The average hoisting speed is 280 feet per minute. The hoist is powered by a 40-horsepower, 250-volt, 142-ampere motor, traveling at a speed of 625 r.p.m. A 6- by 19-, $\frac{3}{4}$-inch-diameter, plow-steel, hemp-center, regular-lay cable, 750 feet long is used. When wound, there are $5\frac{1}{2}$ wraps on the drum; when unwound, one wrap remains. The life of the cable is 18 months. The cable is usually turned end for end after 9 months use. Plain steel idlers, 2 inches in diameter and 18 inches long, mounted on a 1-inch-diameter shaft set in hard wood blocks, 4 by 4 by 16 inches, are spaced 30 feet apart along the entire slope.

The train of eight cars is pulled from the slope bottom to the tipple in $1\frac{3}{4}$ minutes. The total weight of the trip is, roughly, 22 tons. The average daily hoist amounts to 240 cars, divided as follows: 65 cars, or 65 tons of coal; 175 cars, or 350 tons of clay; and 6 cars, or 12 tons of waste.

Generated on 2024-09-18 03:08 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-18 03:12 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

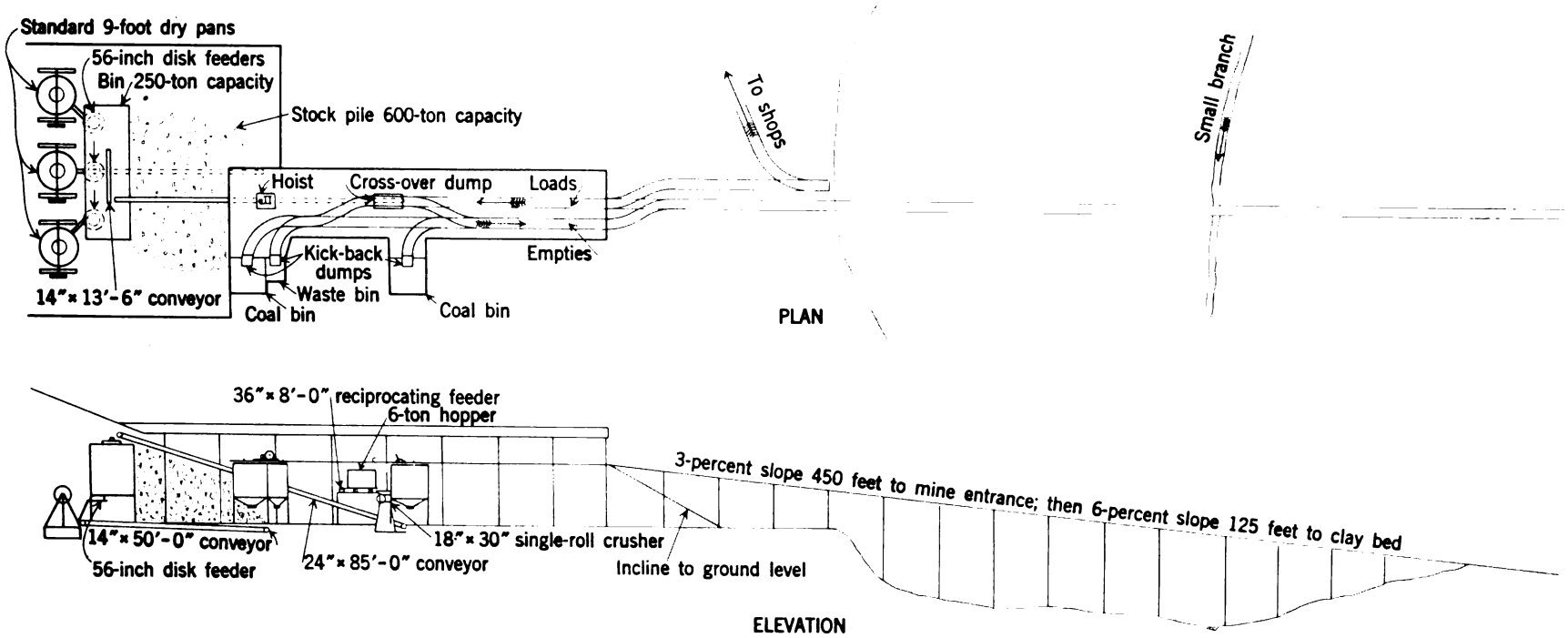


Figure 7.—Tipple and stock pile.

Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-18 03:08 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

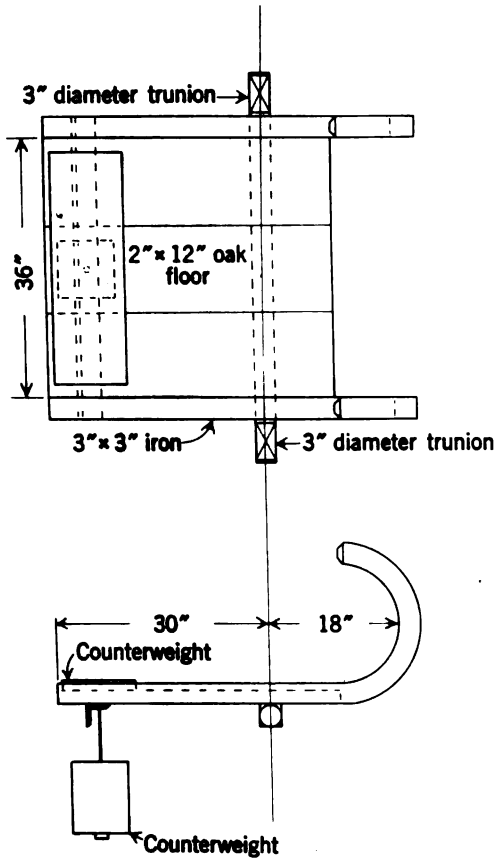


Figure 8.—Kick-back dump.

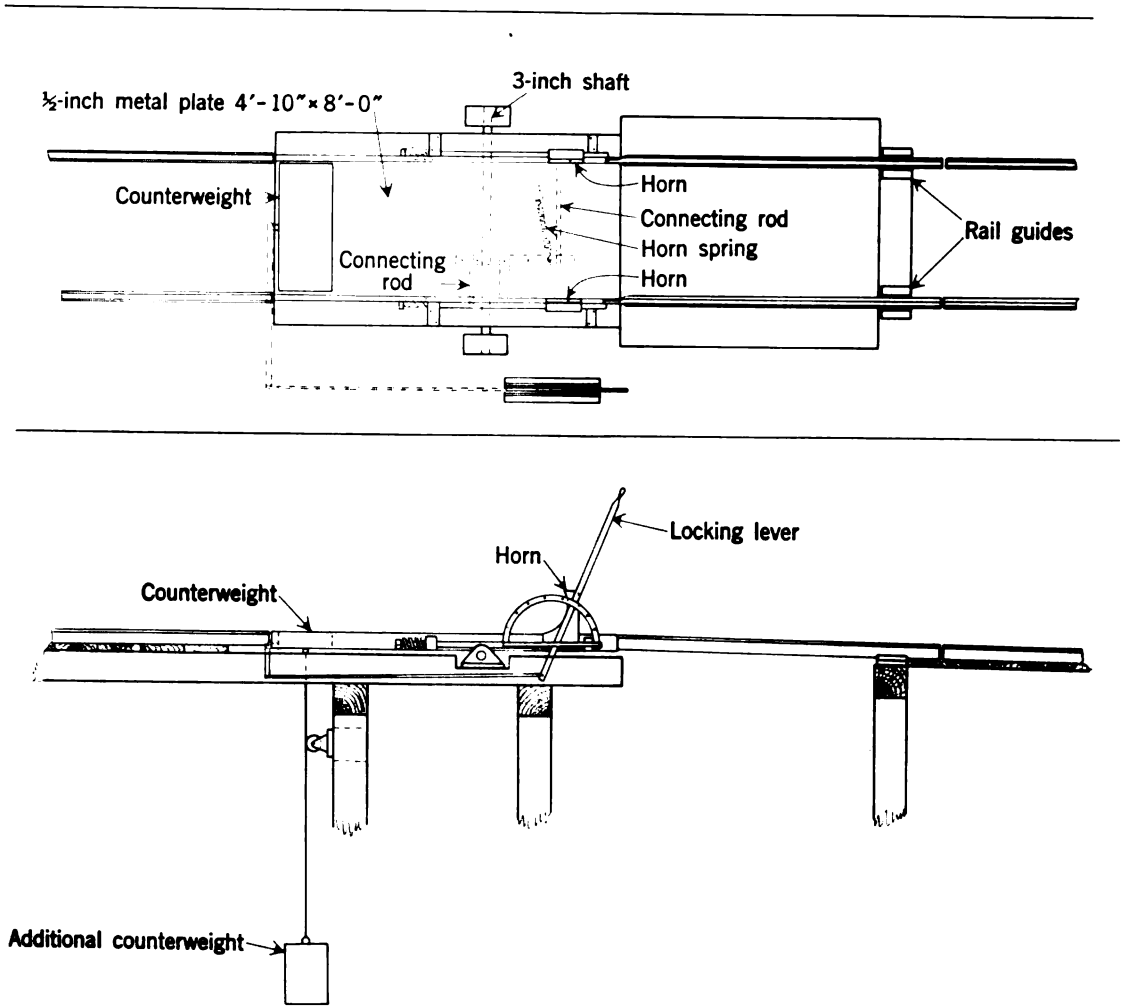
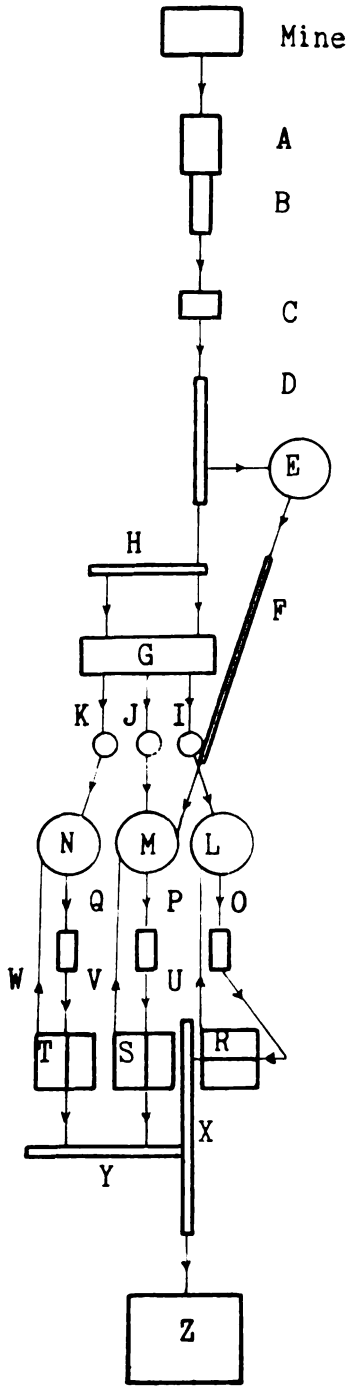


Figure 9.—Cross-over dump.

Original from THE OHIO STATE UNIVERSITY



Legend

A – 6–ton hopper
B – 3' x 8' reciprocating feeder
C – 18" x 30" roll crusher
D – 24" x 85'0" conveyor
E – Stock pile
F – 14" x 50'0" conveyor
G – 250–ton bin
H – 14" x 13'6" conveyor
I – 56"–diameter disk feeder
J – 56"–diameter disk feeder
K – 56"–diameter disk feeder
L – 9' dry pan
M – 9' dry pan
N – 9' dry pan
O – 16" x 46'0" elevator
P – 16" x 46'0" elevator
Q – 16" x 46'0" elevator
R – 3' x 5' electric vibrating screens
S – 3' x 5' electric vibrating screens
T – 3' x 5' electric vibrating screens
U – Chute, plus return to dry pan
V – Chute, plus return to dry pan
W – Chute, plus return to dry pan
X – 18" x 28'0" conveyor
Y – 15" x 26'0" conveyor
Z – 80–ton ground–clay bin

Figure 10.– Flow sheet.

Generated on 2024-09-18 03:09 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

The hoist engineer also operates the roll crusher and the large conveyor belt running from the crusher to the clay bin. Two men assist him in his duties. The simultaneous hoisting of coal, clay, and waste requires considerable tramming on the tipple in order to distribute the materials to their proper places. Figure 7 shows the tipple stockpile and the tipple building in plan and vertical section.

A train of eight cars is handled in the following manner: Upon reaching the top of the tipple, one helper uncouples the hoist cable, pulls it to the front of the tipple, and couples it onto the last car of the train as a safety measure. In the meantime, the second helper has uncoupled the first car and, if it is loaded with clay, moves it forward to the dump over the crusher. Here he is joined by the hoist engineer. The car is dumped, scraped clean with a shovel, and then shifted to the empty-car siding, where it is pushed out to the far end. The first helper, while this is being done, uncouples and pushes forward the second car, where he is joined by the hoist engineer. These two men then push this car to its proper dumping point, which depends upon its contents. When all eight cars have been handled in this manner, the hoist cable is attached and the train is returned to the bottom of the slope.

A "kick-back" dump (fig. 8) 48 inches long, having a 3-inch diameter shaft placed 18 inches from the inside of the curved rail of the horn, is above the coal and waste bins. A "crossover" dump, (fig. 9) 8 feet long, with a 4-inch-diameter shaft placed 24 inches behind the horn, is above the crusher feed hopper. This crossover dump permits the passing of loaded coal and waste cars over the crusher to be dumped into their respective bins in the rear of the building.

Miscellaneous

Sloughing of the top clay bed is very pronounced along the main entries and in the old workings. The room width in some places has increased to 20 feet at these points. Sloughing continues under the coal bed, so that the projecting coal ledge eventually breaks off the falls in a large mass to the sloughed clay below. None of this coal or clay is being recovered at present.

A motor-generator set in the large mill building is used to furnish 250-volt direct current for the mining equipment. This unit is composed of a 105-horsepower, 440-volt, 143-ampere, 109-kv.a., 60-cycle, 3-phase, synchronous-motor direct-connected to a generator of 80-kw., 275-volt, 291-ampere capacity. The unit travels at a speed of 900 r.p.m. and operates 24 hours daily.

SURFACE PLANT

Figure 10 is a flow sheet of the plant.

Generated on 2024-09-18 03:24 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Crushing

The clay is dumped from the mine cars into a wooden hopper (A) constructed of 2- by 6-inch lumber placed flatwise. It is 10 feet long, 10 feet wide, and 5 feet 6 inches deep, and has a capacity of three cars, or 6 tons. A reciprocating plate feeder (B) beneath the hopper feeds the clay into the roll crusher (C). The feeder pan is 8 feet long, 3 feet wide, and moves on four steel single-flanged wheels 10 inches in diameter, the stroke being 6 inches in length. Its capacity, at a speed of 12 strokes per minute, is 150 tons per hour. The feeder is driven by means of a 6-inch rubber transmission belt placed on 14-foot centers from the crusher driveshaft.

The crusher (C) has an 18-inch-diameter roll, 30 inches long, mounted on a 5¼-inch-diameter shaft that turns at a speed of 40 r.p.m. The roll is studded with 3 by 3-inch renewable teeth. The capacity of this crusher, at a peripheral speed of 215 feet per minute, is 100 tons per hour, the maximum size of the product delivered being 4 inches. It is driven through a 10-inch by 16-foot 4-inch transmission belt by a 30-horsepower, 440-volt, 4.2-ampere motor traveling at a speed of 575 r.p.m.

The clay from the crusher falls directly upon a 24-inch by 85-foot rubber conveyor belt (D), whence it is taken either to the stock pile (E) or to the crushed-clay bin (C). The belt is inclined at an angle of 20° above the horizontal over its entire length. The lower 55 feet of the belt is supported on five troughing idlers 6 inches in diameter, 4 inches long, and with 66 inches between sets. The upper 30 feet are supported on 6-inch-diameter flat idlers 26 inches long. The head pulley is 25 inches in diameter, 30-inch face, and travels at a speed of 54 r.p.m. The tail pulley measures 20 inches in diameter and has a 25-inch face. A 10-horsepower, 440-volt, 12.9-ampere motor traveling at 1,150 r.p.m. drives this conveyor through a countershaft drive. The first reduction from the motor has an 8-inch by 12-foot rubber belt; the final reduction to the head shaft has cut spur gears. The capacity of the conveyor, at a speed of 340 feet per minute, is 300 tons per hour.

A single-board plow is used to discharge the crushed clay from the belt onto the stockpile (E), which lies under the upper 30-foot section of the conveyor. The capacity of the stockpile is 600 tons. Figure 7 shows the position of the stockpile.

A 14-inch by 50-foot reclaiming belt (F) is beneath the floor of the stockpile. The belt runs on three troughing idlers 5 inches in diameter and spaced 48 inches apart. The head and tail pulleys are 16 inches in diameter with a 20-inch face, the first pulley traveling at a speed of 60 r.p.m. It is driven through a triple reduction drive by a 10-horsepower, 440-volt, 60-ampere motor whose speed is 1,150 r.p.m. The drive from the motor to the first shaft, 2 inches in diameter, is through a 6- by 11-foot rubber belt; the second reduction to a counter shaft is through a 4- by 62-inch rubber belt; the third reduction to the head shaft is through spur

Generated on 2024-09-18 03:09 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

gears. Removable 2-inch floor boards over the conveyor belt permit of its receiving feed anywhere along the entire length. The conveyor discharges into the second of three dry pans (M). It runs only intermittently, depending entirely upon the grinding capacity of the dry pan.

The crushed-clay bin (G) is 36 feet 6 inches long, 12 feet 6 inches wide, and 13 feet 6 inches deep, its bottom being 7 feet above the ground level. It is made of a double thickness of 1- by 6-inch oak, placed at a right angle of 45° above the horizontal across 2- by 8-inch upright members. Its capacity is 250 tons. The long axis of the bin is placed at right angles to the crusher conveyor, which causes it to discharge at a point 10 feet from one end of the bin. The crushed clay can be discharged either directly into the bin at this point or upon a short movable conveyor (H), which, in turn, distributes the crushed clay throughout the length of the bin. This distributing conveyor is placed in a horizontal position over the center of the bin. The belt is 14 inches wide by 13 feet 6 inches long and runs over 4-inch-diameter flat idlers spaced 36 inches apart. Head and tail pulleys are 16 inches in diameter with an 18-inch face and travel at a speed of 76 r.p.m. The capacity of the conveyor, at a speed of 300 feet per minute, is 35 tons per hour. It is driven through a double reduction drive by a 3-horsepower, 440-volt, 4.4-ampere motor traveling at 1,150 r.p.m. The conveyor and motor are mounted on a wood frame, which, in turn, is mounted on four 10-inch-diameter, single-flanged, steel wheels set on a 56-inch-gage track. A small hand windlass assists in its movement to any position desired.

Three rotary disk feeders (I, J, K), spaced 9 feet apart, are placed below the flat bottom of the storage bin. These feeders are the single-feed, one-side-discharge, concentric type. The diameter of the disks is 56 inches and they turn at 4 r.p.m. A 30-inch-diameter steel hopper 20 inches high connects the disk with the bin. Each feeder is driven through a sprocket and chain from the horizontal shaft of the dry pan to a counter shaft, and then by a bevel gear on the disk bottom. Operation of these feeders is intermittent, depending upon the grinding capacity of the dry pan into which they feed. Their operation is controlled by means of a square jaw clutch mounted on a counter shaft.

Grinding

Three standard 9-foot dry pans (L, M, N) are employed in grinding the clay. These have a forged steel vertical shaft 8 inches in diameter at the bottom and 6 inches in diameter at the top. A forged shoulder near the lower end carries the heavy pan. Mullers 54 inches in diameter and with a 12-inch face provide the necessary grinding action against the pan bottom. Sectional screen plates with 3/16-inch slots are placed just outside the path of the mullers. The life of a muller is 2 years, while that of a screen plate is 6 months. The capacity of each machine, turning at a rate of 32 r.p.m., is 10 tons per hour.

Generated on 2024-09-18 03:10 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

A horizontal countershaft 3 15/16 inches in diameter, placed across the top of the machine, drives the pan through a gear and pinion. A friction clutch pulley 52 inches in diameter, with 16-inch face, mounted on the horizontal shaft, is driven through a 16-inch by 19-foot belt from a main-line shaft at a speed of 102 r.p.m.

Elevating

The ground clay from each pan falls into the well of a separate, wood-enclosed, vertical belt elevator, where it is lifted to the top of the screen room. These three elevators (O, P, Q) are identical in size, speed, and capacity. Buckets 14 by 6 by 5 inches are placed 18 inches apart on a 16-inch rubber belt set on 46-foot centers. The head pulleys are 24 inches in diameter with 18-inch face and travel at a speed of 25 r.p.m. Each elevator is direct-driven through an 8-inch by 28-foot belt from a main-line shaft on the ground floor. The capacity of each elevator, at a speed of 145 feet per minute, is 80 tons per hour.

Screening

Each elevator discharges over a separate electrically vibrated screen. These screens (R, S, T) are made up of two sections of wire cloth, 3 by 5 feet, placed side by side, and are inclined at an angle of 35° above the horizontal. The opening in the cloth is 1/16 by 5/16 inch, the long side of the rectangle being placed at right angles to the flow of material. The life of these cloth sections is two months.

The undersize material falls upon belt conveyors (X, Y) that carry it to the finished-clay storage bin. The oversized material falls into wood chutes (U, V, W) made of 2- by 12-inch lumber and is returned to the dry pans below.

Two conveyors handle the undersize product of the three screens. The first conveyor (X) runs from the screen (R) direct to the finished-clay bin. The product from the other two screens (S, T) falls upon a single conveyor (Y) set at right angles to the first conveyor (X) and upon which it discharges its load. The belt of the first conveyor (X) is 18 inches wide, placed on 28-foot centers, and is inclined at an angle of 17° above horizontal. Four- by 20-inch flat idlers are spaced on 42-inch centers. The head pulley is 16 inches in diameter with an 18-inch face and travels at 36 r.p.m. The tail pulley is 18 inches in diameter with an 18-inch face. The conveyor is driven through a double reduction drive from a main line shaft. The first reduction is a 6-inch belt to a countershaft, and the second reduction is cut spur gears. The capacity of the conveyor, at a speed of 125 feet per minute, is 100 tons per hour.

The second conveyor (Y) is 15 inches by 26 feet and is placed in a horizontal position 2 feet above the floor level. Two troughing idlers, 5 inches in diameter and 6 inches long, are spaced 42 inches apart. The head

Generated on 2024-09-18 03:10 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

and tail pulleys are both 16 inches in diameter, 16-inch face, and travel at 30 r.p.m. This conveyor is driven from a main-line shaft in a manner similar to the drive on the first-described conveyor (X). The capacity of this conveyor, at a speed of 120 feet per minute, is 70 tons per hour.

Ground-Clay Storage Bin

The ground-clay storage bin (Z) is 20 feet long, 9 feet wide, and 7 feet 6 inches deep. It is made of two thicknesses of 1- by 6-inch lumber placed horizontally on 2- by 8-inch uprights. The capacity of this bin is 80 tons of ground clay.

Screen Analysis

A sample of the fine ground clay taken by the writer yielded the following screen analysis. Analysis made in the United States Bureau of Mines laboratory, Pittsburgh, Pa.

Screen Analysis

	Retained on -								Pass
Mesh screen	14	20	35	43	65	100	150	200	200
Percent	7.0	13.3	23.8	7.8	8.4	3.4	11.4	11.3	13.6
Cumulative	-	20.3	44.1	51.9	60.3	63.7	75.1	86.4	-

Specific gravity - 2.628.
Weight per cubic foot - 164.11.

Miscellaneous

A 350-horsepower, 440-volt, 470-ampere, 355-kv.-a., 60-cycle, 3-phase motor traveling at 450-r.p.m. supplies all the motive power in the plant. The motor drives a 4 15/16-inch-diameter main-line shaft at a speed of 165 r.p.m. through a 10-ply rubber transmission belt, 30 inches by 35 feet 6 inches. This shaft, in turn, drives 3 dry pans, 3 elevators, 2 conveyors, 2 a.c. generators, 2 molding machines, and 5 disk feeders.

Two d.c. generators of similar capacity are driven through a 3-inch by 9-foot rubber belt from the main-line shaft. These units are 110-volt, 18.2-ampere, 2-kv.-a., 1-kw., 25-cycle, and travel at a speed of 900 r.p.m. They supply direct current for the three vibrating screens.

A deep well pump having a 3-inch suction, 2-inch discharge, and a 9-inch stroke, with a capacity of 20-gallons per minute, supplies the water used in the plant. This pump is driven through a 4- by 36-inch belt by a 3- horsepower, 440-volt, 4.4-ampere motor traveling at 1,150 r.p.m.

Generated on 2024-09-18 03:11 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Electric Power

Electric power is purchased from the Ohio Power Co. The rate averages $0.04¼ per kw.-hr.

PERCENT EXTRACTION

The initial mining operation yields approximately an 18-percent recovery of both coal and clay. This figure will be increased to 90 percent when all the pillars are recovered. The remaining 10 percent will be lost, due to roof falls, sloughing, and contamination.

EMPLOYEE PAY SYSTEM

Compensation is based on both a tonnage and an hourly rate. The coal miners, together with the clay loaders, are placed on a tonnage basis. The remaining men in both mine and surface plant are on an hourly rate.

FORM OF ADMINISTRATIVE ORGANIZATION

Figure 11 is an organization chart showing the distribution of authority. Each foreman is directly accountable to the general manager for the successful operation of his respective departments. These men usually select their own personnel.

TABLE 1. - Summary of operating costs per ton of clay mined
Period covered: 1936.
Total tons clay loaded: 70,555.

Classification	Labor	Supervision	Air drills, steel	Power, cost	Explosives	Other supplies	Total
Drilling	$0.0534	-	$0.0002	$0.0001	-	$0.0003	$0.0540
Blasting	.0093	-	-	-	$0.0618	.0001	.0712
Loading	.2028	-	-	-	-	-	.2028
Transportation ...	.0790	-	-	.0376	-	.0028	.1194
Timbering	.0026	-	-	-	-	.0001	.0027
Pumping	.0008	-	-	.0163	-	.0010	.0181
Hoisting	.0070	-	-	.0009	-	.0001	.0080
Miscellaneous	.0234	$0.0152	-	.0035	-	.0063	.0484
Total mine ..	.3783	.0152	.0002	.0584	.0618	.0107	.5246
Crushing	.0098	-	-	.0034	-	.0018	.0150
Conveying	.0043	-	-	.0033	-	.0006	.0082
Grinding	.0086	-	-	.0208	-	.0027	.0321
Elevating	.0042	-	-	.0082	-	.0006	.0130
Screening	.0048	-	-	.0006	-	.0018	.0072
Miscellaneous	.0026	.0059	-	.0012	-	.0012	.0109
Total tipple.	.0343	.0059	-	.0375	-	.0087	.0864
Grand total..	.4126	.0211	.0002	.0959	.0618	.0194	.6110

5843

Generated on 2024-09-18 03:07 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-18 03:08 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

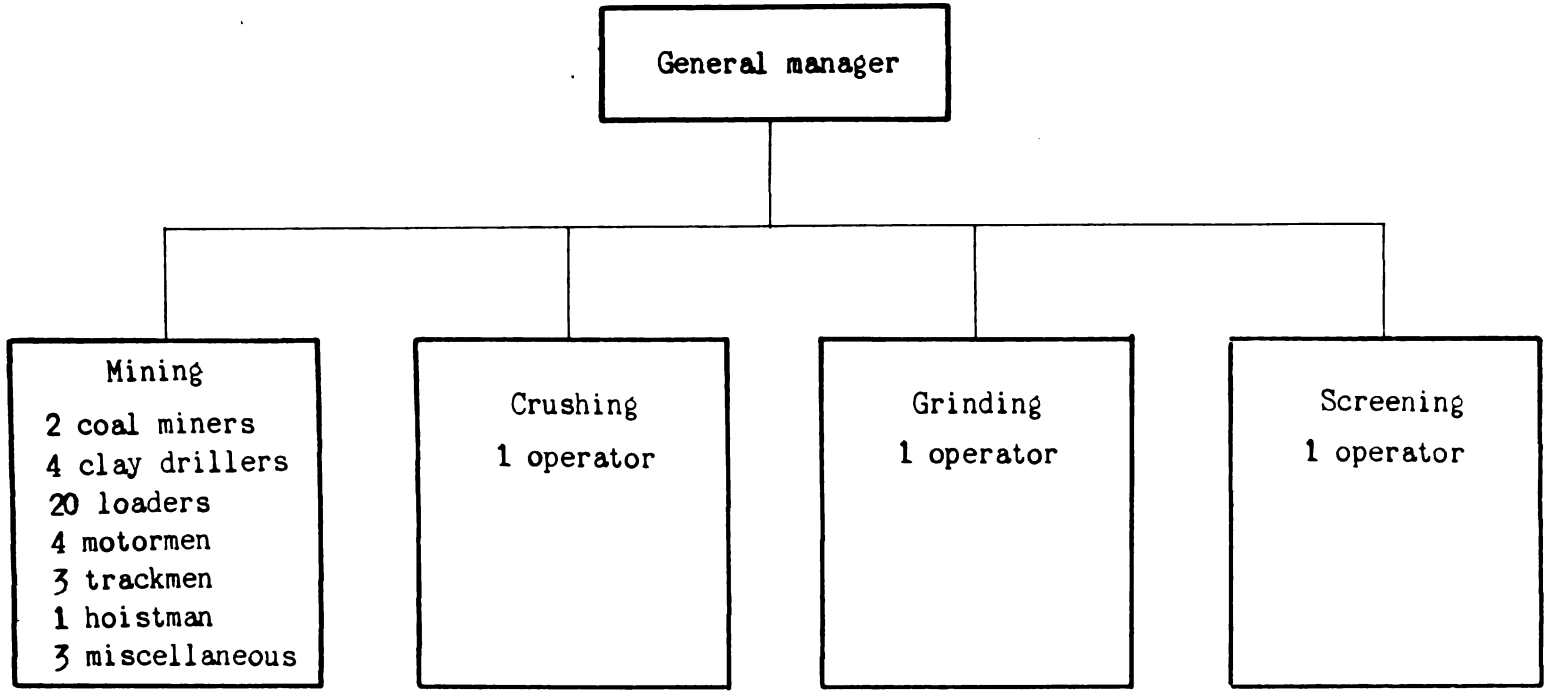


Figure 11.– Organization chart.

Original from THE OHIO STATE UNIVERSITY

TABLE 2. - Summary of operating costs per ton of coal mined
Period covered: 1936.
Total tons coal loaded: 13,545

Classification	Labor	Super-vision	Power, cost	Explosives	Other supplies	Total
Drilling	$0.0322	-	-	-	-	$0.0322
Blasting	.0212	-	-	$0.0206	-	.0418
Loading	.4000	-	-	-	-	.4000
Transportation ...	.0150	-	$0.0071	-	$0.0005	.0226
Timbering	.0005	-	-	-	.0001	.0006
Pumping	.0001	-	.0031	-	.0002	.0034
Hoisting	.0013	-	.0002	-	.0001	.0016
Miscellaneous	.0045	$0.0029	.0007	-	.0012	.0093
Total	.4748	.0029	.0111	.0206	.0021	.5115

TABLE 3. - Detailed summary costs, direct-operation mine, clay and coal
Period covered: 1936.
Total tons loaded: 84,100.

Classification	Amount	Cost per ton	Total cost per ton
Loading	$20,487.47	$0.2440	$0.2440
Drilling:			
Operating labor	3,948.30	.0470	-
Repair labor	262.00	.0031	-
Power	4.00	.0001	-
Operating supplies	15.00	.0002	-
Repair supplies	25.00	.0003	-
Total drilling	4,254.30	-	.0507
Blasting:			
Labor	940.95	.0111	-
Explosives	4,642.95	.0551	-
Other supplies	10.00	.0002	-
Total blasting	5,593.90	-	.0664
Hauling:			
Locomotive	9,375.00	.1118	-
Cars	175.00	.0020	-
Track	2,378.00	.0282	-
Total hauling	11,928.00	-	.1420
Timbering:			
Labor	264.00	.0031	-
Supplies	21.60	.0002	-
Total timbering	285.60	-	0.0033
General charges	7,451.97	-	.0888
Grand total	50,001.24	-	.5952

5843

Generated on 2024-09-18 03:07 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 4. - Summary of costs in units of labor, power, and supplies, clay
Period covered: 1936.
Total tons clay loaded: 70,555.

	Mining	Crushing	Other	Total
Labor (man-hr. per ton):				
Drilling	0.062	-	-	0.062
Blasting	.017	-	-	.017
Loading	.371	-	-	.371
Hauling	.091	-	-	.091
Timbering	.011	-	-	.011
Miscellaneous	.057	.022	.044	.123
Supervision	.023	.001	.001	.025
Total labor	.632	.023	.045	.700
Average tons per man per shift.	-	-	-	9.722
Labor, percent of total cost	-	-	-	72.11
Power-supplies:				
Explosives (pounds per ton)	-	-	-	.40
Total power (kw.-hr. per ton):				
Drills	.038	-	-	.038
Locomotive	4.200	-	-	4.200
Pumps	1.022	-	-	1.022
Ventilation	.191	-	-	.191
Hoisting	.106	-	-	.106
Crushing	-	.320	-	.320
Conveying	-	-	.311	.311
Elevating	-	-	.765	.765
Grinding	-	-	2.045	2.045
Screening	-	-	.057	.057
Other supplies, percent of total supplies	-	-	-	8.16
Supplies and power, percent of total cost	-	-	-	27.89

Generated on 2024-09-18 03:09 GMT / https://hdl.handle.net/2027/osu.32435030644025
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY